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Highly conductive micropaths made from assembled 1D particle structures

The possibility of arranging microparticle patterns on a substrate—with the accuracy of a single particle—may serve as a starting point for the development of new technological processes and industrial solutions. Appropriately laying out microparticles on different solid surfaces to form planar structures can be used, for instance, in optics as optical waveguides, and in electronics for electromagnetic energy transport and as conductive tracks [1,2].

In regard to conductive micropaths, there are several advantages of using microparticles aligned side by side and forming single-particle-thick paths. These include superior electronic conductivity, e.g., comparing to commonly used micropaths made of sintered nanoparticles. When the neighbouring particles in the deposited 1D structures are physically connected, the obtained electrical resistivity of such micropaths can be as low as the bulk particle material. In addition, the height-to-wight ratio of such structures is far higher than that of traditionally produced conductive lines. Moreover, the cost of microparticles is typically lower than that of nanoparticles, making them excellent candidates for conductive micropaths.

In my presentation, I will demonstrate a robust and easy to implement method that facilitates the continuous production of particle paths on various substrates, using a variety of particle types. The method involves synergetic action of electric-field assembly, capillary and electrostatic interactions [3]. The as-deposited structures are characterized by low conductivity (related to a small initial contact area between the neighbouring particles) and require particle fusing. In the second part of the presentation, I will show the results of the study on mechanical compression of particle chains—precise approach that can be used to deform and join malleable materials and eventually obtain highly conductive micropaths of desired conductivity and height-to-weight aspect ratio. The results indicate great potential for future applications of these post-processed microstructures in electronics.

Literature:

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[2] Fabrication of 1D particle structures outside liquid environment using electric and capillary interactions: from fundamentals to applications, Z. Rozynek, Y. Harkavyi and K. Giżyński, *Materials & Design* **223**, 111233 (2022)

[3] Patent, https://patents.google.com/patent/US20210235585A1/en